

## NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

### Surface Drainage, Main or Lateral (FT) No. 608

#### Definition

An open drainage ditch constructed to a designed size and grade.

#### Purpose

To dispose of excess surface or subsurface water, intercept ground water, control ground water levels, provide for leaching of saline or alkali soils, or a combination of these objectives.

#### Conditions Where Practice Applies

All lands to be drained shall be suitable for agriculture after installation of required drainage and other conservation practices.

In areas where an outlet for the drainage system will be available, either by gravity flow or by pumping. The outlet shall be adequate for the quantity and quality of water being drained. Consideration shall be given to possible damages above or below the point of discharge that might involve legal actions.

This standard does not apply to field ditch (607).

***Where soils have a low permeability and closed drains are not applicable to collect subsurface flow. Refer to the Drainage Handbook for West Virginia for applicability of surface drainage.***

***Where the water table is sufficiently high to hinder the production of crops, and it is feasible to control the water table by surface drainage, subsurface drainage, or both.***

#### ***Federal, State, and Local Laws<sup>1</sup>***

NRCS, October 1978

***Design and construction activities shall comply with all federal, state, and local laws, rules, and regulations governing pollution abatement, health, and safety. The owner or operator shall be responsible for securing all required permits or approvals and for performing in accordance with such laws and regulations. NRCS employees are not to assume responsibility for procuring these permits, rights, or approvals, or for enforcing laws and regulations. NRCS may provide the landowner or operator with technical information needed to obtain the required rights or approvals to construct, operate, and maintain the practice.***

***Permits may be required from the following agencies:***

- 1. West Virginia Department of Health***
- 2. West Virginia Department of Agriculture***

#### **Planning Considerations**

##### Water Quantity

- Effects on the water budget components, especially with regard to effects on runoff, soil water, and water tables.
- Potential changes in soil moisture that will affect the growth of desirable vegetation.
- Effect on ground water recharge.

##### Water Quality

NRCS-WV, TG-IV, October 1996

1. Effects on the detachment and transport of sediment and chemicals and dissolved and sediment-attached substances into water courses.
2. Effects on the salinity of drained soils and downstream water courses.
3. Effects on wetlands.
4. Effect on the quality of ground water.
5. Potential for changes in downstream water temperature.
6. Effects on downstream visual quality.

## Design Criteria

The design and installation shall be based on adequate surveys and investigations.

**Drainage requirements.** Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs. The degree of drainage required by the crops shall be determined and expressed in terms of drainage coefficients or depth and spacing of drains.

***The degree of drainage required by the crops and land use on the different soils needing drainage is set forth in the Drainage Handbook for West Virginia.***

**Capacity.** The ditch capacity shall be adequate to provide for the removal of excess water, based on climatic and soil conditions and the needs of crops. The required capacity shall be obtained by determining the watershed area; the required topographic, soil, and land use information; and use of the appropriate drainage coefficient curves.

The required capacity of open ditches for subsurface drainage in western irrigated areas shall be determined by evaluating site conditions, including irrigation water deliveries, irrigation canal or ditch losses, soil stratification and permeability, deep percolation losses, field irrigation losses, subsurface drain discharge, and quantity of surface water to be carried by the drainage ditch.

***Drainage mains and laterals must have sufficient capacity to carry and dispose of the runoff from the contributing watershed in sufficient time to permit crop production on the area treated. Runoff will be determined from Drainage Runoff Curves, Exhibit 14-2 or Exhibit 14-2.1 of the Engineering Field Handbook. The minimum drainage coefficient will be the Curve "C" in accordance with the Drainage Handbook for West Virginia. Curves "A" and "B" may be used where a higher degree of drainage or protection from flooding is justified, or the higher degree is required by the Drainage Handbook.***

***The design for capacity will be calculated by Manning's equation in accordance with the procedures outlined in detail in Chapter 14 of the Engineering Field Handbook. Capacities may be determined from either Exhibit 14-6, 14-6.1, or 14-6.2, as applicable, Chapter 14, Engineering Field Handbook, in lieu of computed values.***

**Hydraulic gradeline.** The hydraulic gradeline for drainage ditch design shall be determined from control points, including elevations of significant low areas served by the ditch and hydraulic gradelines of any tributary ditches and the outlet. If control point elevations are estimated rather than computed from survey data, the hydraulic gradeline shall be no less than:

1. 1 ft below fields that will receive normal drainage from ditches draining more than 1 mi<sup>2</sup>.
2. 0.5 ft for ditches draining 40 to 640 acres.
3. 0.3 ft for ditches draining less than 40 acres.

For lands to be used only for water-tolerant crops, such as trees and grasses, these requirements may be modified and the hydraulic gradeline set at ground level. These provisions do not apply to channels where flow is contained by dikes.

The effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be considered.

***Bridges, culverts, and structures shall be of such size and placement that the design runoff will pass within bank flow, except that culverts and bridges at public road crossings***

**shall have sufficient minimum capacity to meet criteria of public road authorities.**

***In the lower reaches, out-of-bank flow will be permitted where it will not cause damage or impair the functioning of the planned drainage system.***

**Depth.** Drainage ditches shall be designed deep enough to allow for normal siltation. If needed, the design depth and capacity may be increased to provide adequate subsurface drainage or for normal flow. The increase shall be based on an evaluation of site conditions. Ditches that serve as outlets for subsurface drains shall be designed for a normal water surface at or below the invert of the outlet end of the drain. The clearance between a drain invert and the ditch bottom shall be at least 1 ft for ditches that fill with sediment at a normal rate, except where lower values are specified for a job because of unusual site conditions. The normal water surface is the elevation of the usual low flow during the growing season.

**Cross section.** The design ditch cross section shall be set below the design hydraulic grade line and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and, if needed, allowances for initial sedimentation. Side slopes shall be stable, shall meet maintenance requirements, and shall be designed on the basis of on-site conditions.

**Velocity.** The maximum permissible design velocity shall be based on site conditions and shall insure stability of the ditch bottom and side slopes. A desirable minimum velocity is 1.5 ft/s. On flat grades, a channel cross section shall be selected on the basis of the depth and maintenance requirements, which will result in the desirable minimum velocity if possible.

The design for newly constructed surface drains with drainage areas in excess of 1 mi<sup>2</sup> shall meet the requirements specified for Open Channel (582).

***The maximum velocity for channels with drainage areas less than 1 mi<sup>2</sup> shall be in accordance with the following table:***

**Velocity**

<b>Soil Material</b>	<b>ft/sec</b>
<i>Fine Clean Sands (SW, SP)</i>	1.5
<i>Silty Sand (SM)</i>	2.0
<i>Coarse Clean Sand (SW, SP)</i>	2.5
<i>Alluvial Silt, Noncolloidal (ML)</i>	2.5
<i>Alluvial Silt, Colloidal (MH)</i>	3.0
<i>Clayey Sand (SC)</i>	3.0
<i>Lean to Moderately Cohesive Clay (CL)</i>	3.0
<i>Silty Gravel (GM)</i>	3.5
<i>Fine Clean Gravel (GW, GP)</i>	4.0
<i>Clayey Gravel (GC)</i>	4.5
<i>Stiff Clay (CH)</i>	4.5
<i>Coarse Clean Gravel (GW, GP)</i>	5.0
<i>Cobbles and Boulders</i>	6.0
<i>Weathered Shale and Hardpan</i>	6.0

**Capacity design.** Manning's Formula shall be used in determining the design velocity, and the value of n shall be based on alignment, probable vegetative growth expected with normal maintenance, other roughness factors, and the hydraulic radius. Unless special site studies are available to justify other values, the following values of n, based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving the Manning Formula for mains and laterals when determining the design for required capacity.

<b>Hydraulic radius</b>	<b>n</b>
Less than 2.5.....	0.040-0.045
2.5 to 4.0.....	.035 - .040
4.1 to 5.0.....	.030 - .035
More than 5.0.....	.025 - .030

**Berms and spoil banks.** Adequate berms shall be provided and shaped, as required, to provide access for maintenance equipment, to eliminate the need for moving spoil banks in future operations, to provide for work areas and facilitate spoilbank spreading, to prevent excavated material from washing or rolling back into ditches, and to lessen sloughing of ditchbanks caused by heavy loads too near the edge of the ditchbanks. The following minimum berm widths shall be provided, except where spoil is spread according to the standard for Spoil Spreading (572):

Ditch depth	Min. berm width
ft	ft
2-6.....	8
6-8.....	10
More than 8.....	15

If spoil material is to be placed in banks along the ditch rather than spread over adjacent fields, the spoilbanks shall have stable side slopes. Provision must be made to channel water through the spoil and into the ditch without causing serious erosion.

**Related structures and ditch protection.** Mains and laterals shall be protected against erosion by chutes, drop structures, pipe drops, other suitable structures or grassed waterway, or specially graded channel entrances where surface water or shallow ditches enter deeper ditches.

Grade control structures, bank protection, or other suitable measures shall be used if necessary to reduce velocities and control erosion.

Culverts and bridges shall have enough hydraulic capacity and depth for drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures generally shall be determined by use of the applicable drainage coefficients with the "island-type" of construction used to protect the structure from washout.

Each structure for an open ditch system shall be designed according to NRCS standards for the kind of structure and type of construction used.

**Channel vegetation.** Vegetation shall be established according to the standard for channel vegetation (322).

## Plans and Specifications

Plans and specifications for constructing mains or laterals shall be in keeping with this standard and shall describe the requirements for constructing the practice to achieve its intended purpose.

## Operation and maintenance.

Requirements for operating and maintaining drainage mains and laterals shall be according to the standard for Open Channel (582).

***<sup>1</sup>Bold italics is information added to the National standard by West Virginia***

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE GENERAL SPECIFICATIONS**

**Surface Drainage, Main or Lateral  
(FT)  
No. 608**

**Clearing**

The channel area shall be cleared of trees, logs, stumps, and other materials necessary for construction. Care must be taken to protect all trees to be saved for environmental purposes. All material shall be disposed of by an acceptable method as shown on the plans.

**Excavation**

Channels shall be excavated to line and grade as shown on the plans or as staked in the field. The excavated surface shall be reasonably smooth.

Construction activities shall be carried on in a manner that will not restrict flow from upstream channels. Care must be taken to reduce and prevent sediment pollution of water.

**Spoil**

Spoil shall be disposed of as shown on the plans or as marked in the field.

**Structures**

All structures and other related protection devices shall be installed as the work progresses to permit proper functioning of the ditch and to prevent environmental damage during the installation period.

**Vegetation**

Vegetation shall be planted at times and rates shown in the plans or in the specifications for each job.